Oilseed Crushing and Processing

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Feedstock Preparation

- Biodiesel can be made from vegetable oils, animal fats, and recycled oils.
- Animal fats and recycled oils must be rendered (water removed).
- In the U.S., most oil is from soybeans. In Canada and Europe, canola is important. In Asia, palm is the leading source of oil.
- Most oilseeds are processed using similar processes.

Processing vegetable oils

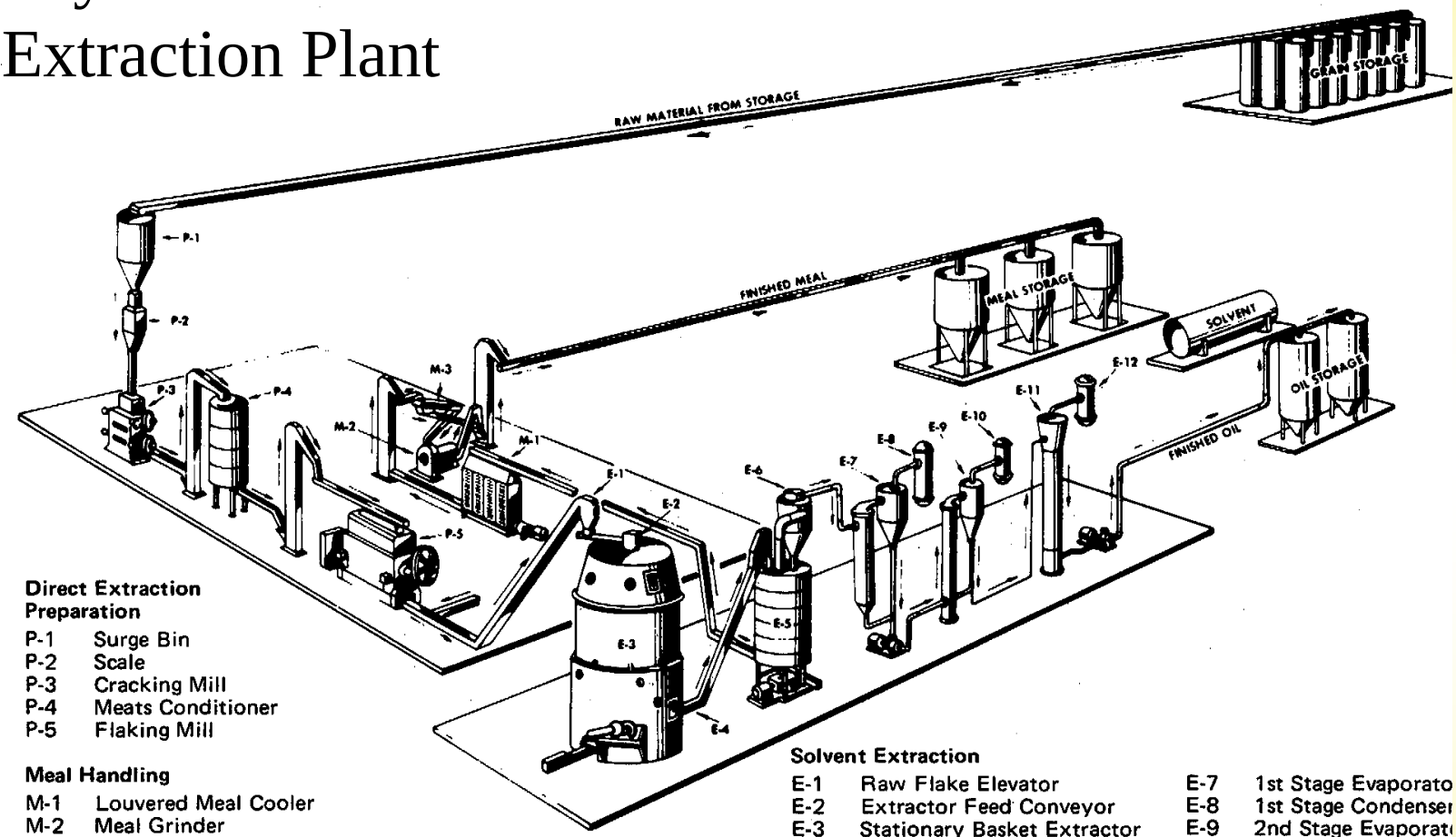
- Extraction
- Refining (degumming and neutralization)
- Bleaching
- Deodorizing

RBD = Refined, bleached, and deodorized

Vegetable oil extraction

- Vegetable oils can be extracted from the oilseed (or fruit) in two basic ways:
  - Solvent extraction
  - Mechanical extraction
- Some plants use a combination (prepressing followed by solvent extraction)

Soybean Oil Extraction Plant



Direct Extraction Preparation

P-1 Surge Bin
P-2 Scale
P-3 Cracking Mill
P-4 Meats Conditioner
P-5 Flaking Mill

Meal Handling

M-1 Louvered Meal Cooler
M-2 Meal Grinder
M-3 Meal Screen

Solvent Extraction

E-1 Raw Flake Elevator
E-2 Extractor Feed Conveyor
E-3 Stationary Basket Extractor
E-4 Spent Flake Elevator
E-5 Desolventizer Toaster
E-6 Vapor Scrubber
E-7 1st Stage Evaporato
E-8 1st Stage Condenser
E-9 2nd Stage Evaporat
E-10 2nd Stage Condense
E-11 Final Oil Stripper
E-12 Vacuum Condenser

Cooking

- Soybeans and rapeseed contain enzymes that can make the meal unsuitable for use as feed.
- The enzymes can be destroyed by heating to 150-160°C. This can be done before or after oil extraction.

Common vegetable oil contaminants

- Gums (phospholipids, phosphotides) – phosphorus-containing compounds
- Free fatty acids
- Unsaponifiable matter (sterols, tocopherol, hydrocarbons)

Composition of Crude and Refined Soybean Oils

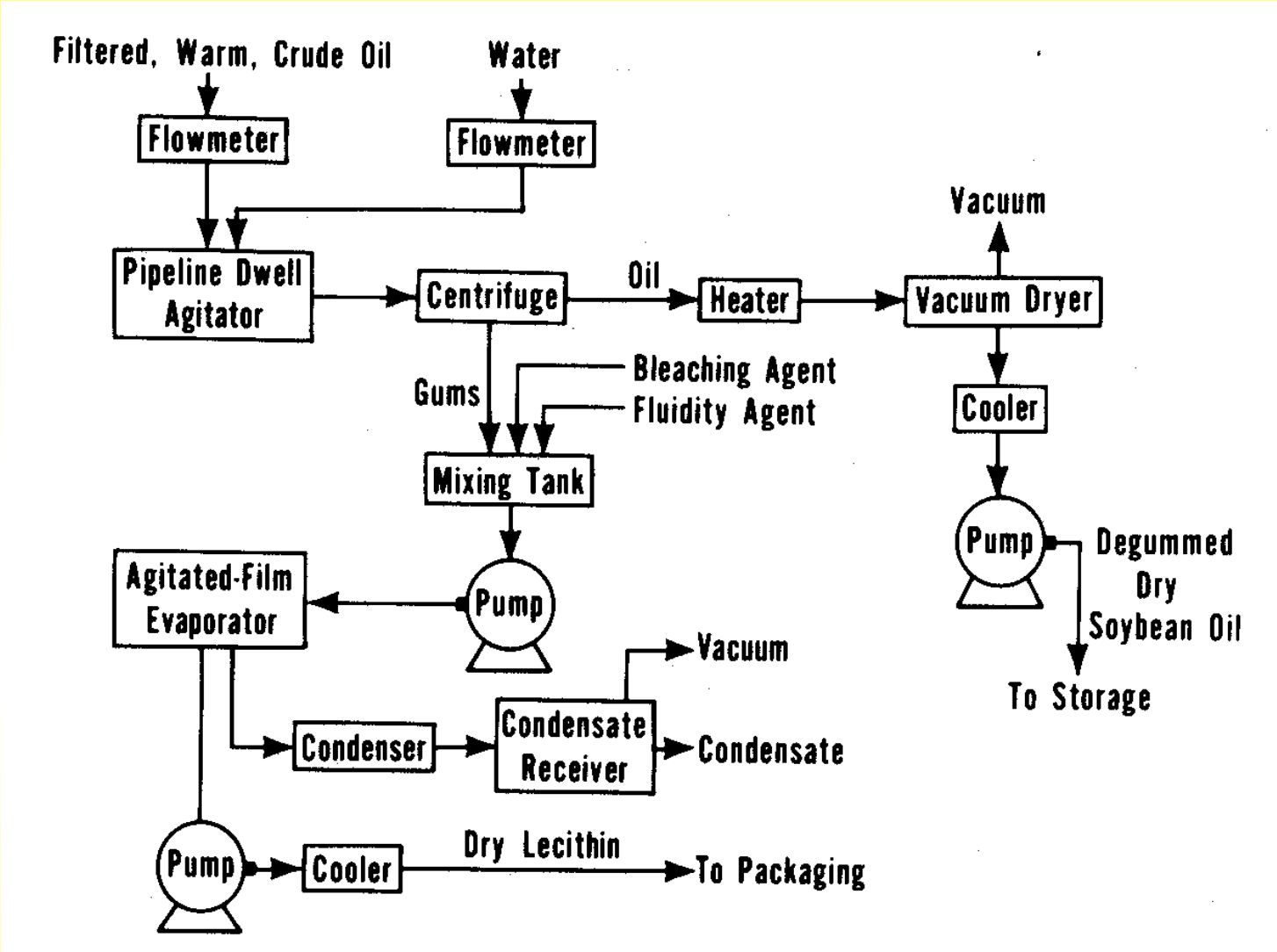
	Crude Oil	Refined Oil
Triglycerides, %	95 – 97	>99
Phosphatides, % [a,b]	1.5 – 2.5	0.003 – 0.045[c]
Unsaponifiable Matter, %	1.6	0.3
Plant sterols, % [d]	0.33	0.13
Tocopherols, % [e]	0.15 – 0.21	0.11 – 0.18
Hydrocarbons, % [f]	0.014	0.01
Free fatty acids, %	0.3 – 0.7	< 0.05
Trace Metals[a]		
Iron, ppm	1 – 3	0.1 – 0.3
Copper, ppm	0.03 – 0.05	0.02 – 0.06

Oil processing

- Crude vegetable oil can be used directly for biodiesel production.
- Phospholipids and most other contaminants will end up in glycerol. This complicates glycerol clean-up.
- Refined oils are less problematic – contain no emulsifiers – and give greatest yield.

Degumming

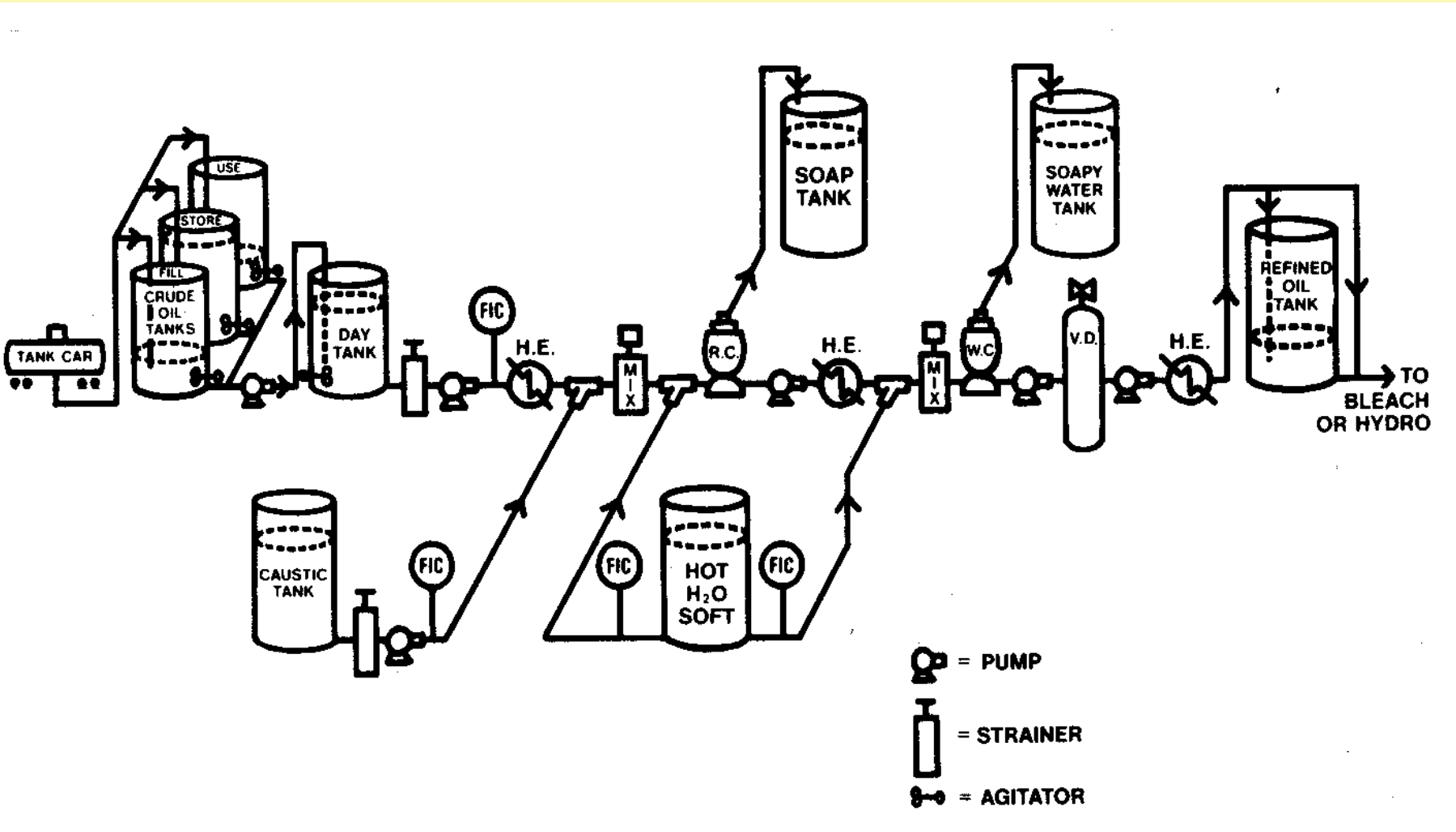
- Degumming is removal of phosphorus compounds.
- Water degumming can usually take phosphorus from 600-900 ppm down to 50-80 ppm. Some guns are not hydratable.
- Phosphoric acid (or citric acid) can remove almost all gums but lecithin may not be edible.



Soybean Oil Degumming

Caustic Refining

- Crude soy or canola oil may contain 0.3 – 0.7% free fatty acids.
- FFAs are removed by adding sodium hydroxide – water solution and converting FFAs to soap. Then soap is washed out.
- Resulting product is *soapstock*, a potential low cost feedstock for biodiesel.
- Soapstock may, or may not, contain gums.



Caustic Refining of Soybean Oil

Bleaching

- Bleaching is used to remove color and may also remove remaining FFAs, soap, metals, gums, peroxides.
- Add an absorbant clay powder, agitate at 90-120°C, filter out powder.
- Spent bleaching clay is a fire hazard and may be a low cost source of biodiesel.

Deodorization

- Trace compounds may remain that give a taste and odor to the oil. These are removed by distillation.
- Deodorization can remove some or most of the tocopherol (vitamin E), which is useful for controlling oxidation.
- Deodorizer distillate (residue) is an important source of vitamin E.

Requirements for biodiesel

- Water < 0.1%
- Free fatty acids < 0.5%
- Gums < 50 ppm P
  - Note that the biodiesel specification limits phosphorus to 10 ppm, but most goes with glycerin.
- Bleaching and deodorization are not required (except for some recycled greases).

Summary

- Canola and soybeans are processed in a similar manner.
- Degumming and caustic stripping are recommended for biodiesel production.